DIGITAL GUNNERY: HOW COMBAT VEHICLE GUNNERY TRAINING CREATES A MODEL FOR TRAINING THE MISSION COMMAND SYSTEM

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The Army has a suite of digital systems that give commanders an unprecedented ability to understand and lead in the battlefields where they operate. Unfortunately, units consistently underperform when tasked with using these systems at critical evaluations. With a multitude of systems and challenging, but necessary learning curves to achieve proficiency, units do not have a clear process with which to train their operators to function as a cohesive staff. Weapon systems, on the other hand, have a clear training plan that takes the individual operator, incorporates them into a team, and then places that team with a larger unit.

This study endeavors to show that combat vehicle gunnery training model is useful and can be applied to training digital system operators and, ultimately, the unit's mission command system. Historical gunnery training manuals, after-action-reviews, and doctrine will be used to describe how to create a digital gunnery program.

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

DIGITAL GUNNERY: HOW COMBAT VEHICLE GUNNERY TRAINING CREATES A MODEL FOR TRAINING THE MISSION COMMAND SYSTEM, by Major Jonathan Stafford, 80 pages.

The Army has a suite of digital systems that give commanders an unprecedented ability to understand and lead in the battlefields where they operate. Unfortunately, units consistently underperform when tasked with using these systems at critical evaluations. With a multitude of systems and challenging, but necessary learning curves to achieve proficiency, units do not have a clear process with which to train their operators to function as a cohesive staff. Weapon systems, on the other hand, have a clear training plan that takes the individual operator, incorporates them into a team, and then places that team with a larger unit.

This study endeavors to show that combat vehicle gunnery training model is useful and can be applied to training digital system operators and, ultimately, the unit's mission command system. Historical gunnery training manuals, after-action-reviews, and doctrine will be used to describe how to create a digital gunnery program.

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ACRONYMS

ABCS	Army Battle Command System
ABCT	Armored Brigade Combat Teams
AFATDS	Advanced Field Artillery Data System
ALOC	Army Logistics Operation Center
AMDWS	Air and Missile Defense Workstation
ARI	Army Research Institute
ASCC	Army Service Component Command
BATS	Bradley Advanced Training System
BCT	Brigade Combat Team
BFT	Blue Force Tracker
BFV	Bradley Fighting Vehicle
CALFEX	Combined Arms Live-Fire Exercises
CCTT	Close Combat Tactical Trainer
COIC	Combined Operations and Intelligence Center
COP	Common Operating Picture
CP	Command Post
CPOF	Command Post of the Future
CTC	Combat Training Center
DATE	Decisive Action Training Environment
DCGS-A	Distributed Common Ground System-Army
DO	Division Officer
FBCB2	Force XXI Battle Command Brigade and Below

FM	Field Manual
FORSCOM	Forces Command
FY	Fiscal Year
JAGIC	Intelligence Cell, Joint Air Ground Coordinate Center
JBC-P	Joint Battle Command-Platform
JCR	Joint Capabilities Release
JCR-Log	JCR-Logistics
KM	Knowledge Management
MC	Mission Command
MCCOE	Mission Command Center of Excellence
MCDMG	Mission Command Digital Master Gunner
MCIS	Mission Command Information System
MCS	Mission Command System
MCTP	Mission Command Training Program
MCVE	Mission Command Validation Exercise
MCWS	Mission Command Workstation
NET	New Equipment Training
TAIS	Tactical Airspace Integration System
TCM	Tactical Mission Command
WFX	Warfighter Exercise

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CHAPTER 1

INTRODUCTION

Introduction and Background of the Problem

> You cannot have too much gunnery. It is the most important phase and the least likely to improve on the battlefield. . . . Gunnery must be automatic. . . . The battlefield is a poor place to learn shooting.[1]
>
> — Unknown battalion commander
> 5th Armored Division, European Theater, 1945

Every weapon system in the U.S. Army has a comprehensive training plan. Each system's training program walks the individual operator through maintenance, personal use, and crew or squad collective use, then through several additional echelons of simultaneous and supporting use. The M2A3 Bradley fighting vehicle gunner traverses through a significant training regime to become a member of a fighting Brigade Combat Team (BCT). Starting with vehicle familiarization, the gunner learns how to operate and maintain the vehicle before progressing to the specific mechanisms and application of the main and secondary weapon systems. Simultaneously, the Bradley's driver and commander are training on their individual responsibilities. Once each member has mastered their tasks, the crew comes together to operate the vehicle as a crew in a simulated environment – the Bradley Advanced Training System (BATS) where they simulate qualification. After virtual qualification is complete, the Bradley Fighting Vehicle (BFV) crew begins section, platoon, and then company virtual collective training in the Close Combat Tactical Trainer (CCTT). Only once this is complete, does the

[1] U.S. Forces, European Theater, *Reports of the General Board* (Fort Leavenworth, KS: U.S. Army Combined Arms Center, 1945), 18-20.

vehicle crew move to a qualification range to fire live rounds. Qualification, in this case, is divided into tables, ranging from critical crew skills, table 1, through platoon qualification, table 7. Next, the crews participate in a combined arms live-fire exercises (CALFEX) at the company, battalion, and, ideally, the brigade level. This regimen is not unique to the BFV; the M1A2 Abrams main battle tank, AH64 Apache helicopter, M120 mortar, M109AG howitzer, and even M4 carbine each have a similar progressive training model to train the operator, and have them function as a much larger team with collective goals. This highly effective program, however, does not apply to the command and control systems that coordinate the finely tuned BCT or division and their considerable combat power. These digital command and control systems for the Army are critical for the commander to defeat the enemies of today decisively – and tomorrow.

Today's digital systems operators attend a course to learn their system, and then begin working as part of a unit's staff. The operator of a Command Post of the Future (CPOF) uses the system collaboratively to visualize the battlefield, create plans, conduct rehearsals, and keep the commander apprised of friendly units on the battlefield. Concurrently, an Advanced Field Artillery Tactical Data System (AFATDS) user attends their course and works on the unit's staff. The AFATDS user performs many critical duties to include fire planning, target nomination, and fires clearance. The CPOF and AFATDS operator function together much like the driver and gunner in a BFV, and both operators receive input from the equivalent of the track commander – the operator's section chief, operations officer, or unit commander. As such, the different digital systems' operators function as a crew. This crew then works with other crews, system operators in the Army Logistics Operation Center (ALOC), Intelligence Cell, Joint Air

Ground Coordinate Center (JAGIC), and counterpart elements in other command posts (CP).

Unfortunately, they are not trained to work as a team. Digital system operators learn their associated systems, and begin to function as a team only when their team is setting up for an exercise. Consequently, units waste critical training time at Combat Training Centers (CTCs) learning how to operate their specific assigned digital system as a part of an efficient Mission Command System (MCS), instead of honing an already functioning team.

To rectify this situation, the Army must establish a digital gunnery program that trains digital systems to work in a unified manner and certifies a unit's staff as a MCS as a whole. Commanders must understand the program and prioritize digital gunnery by scheduling it on the training calendar and stabilizing members of their digital crews. Until this training program is complete, leaders will be unable to maximize the coordination capability of their staffs that contribute to the lethality of their combat formations.

Research Questions

The purpose of this research is to determine how to train staffs effectively on mission command as a weapon system through digital gunnery. Several questions must be analyzed in order to answer this question effectively.

1. How effectively does the Army currently train operators on the different digital systems?
2. How effectively does the Army employ assigned digital systems to form an effective MCS?
3. How and why did combat vehicle gunnery develop to its current state?

4. How effective is combat vehicle gunnery training?

5. Can the principles and format of vehicle gunnery training be applied to training a staff MCS?

Definition of Key Terms

Advanced Field Artillery Data System (AFATDS). A digital fire support system in battalion through corps CPs that enables coordination of fire support systems.[2]

Air and Missile Defense Workstation (AMDWS). A digital system found in CPs from brigade through ASCC used to manage air defense weapons and sensors.[3]

Army Service Component Command (ASCC). The Army command responsible for giving recommendations to a joint force or combatant commander on how to best use Army forces.[4]

Command Post of the Future (CPOF). "A decision support system" that enables units from company through ASCC to make decisions, plan, rehearse, and manage execution of missions in a collaborative environment. Also known as the Mission Command Workstation or Tactical Mission Command (TCM) workstation.[5]

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[2] U.S. Army, Program Executive Office Command, Control and Communications-Tactical (PEO-C3T), "Command Post Handbook," Army Training Network, 30 July 2013, accessed 22 September 2016, https://atn.army.mil/media/docs/CP-Handbook-2013-07-30.pdf, 24.

[3] PEO-C3T, 25.

[4] Joint Chiefs of Staff, Joint Publication (JP) 1-02, *Department of Defense Dictionary of Military and Associated Terms* (Washington, DC: U.S. Joint Chiefs of Staff, 2016), 15.

[5] PEO-C3T, 27.

Distributed Common Ground System-Army (DCGS-A). A digital intelligence synchronization system that integrates collection, terrain, weather, enemy, and space data to provide relevant intelligence information to the commander. The DCGS-A is in CPs from the intelligence company through ASCC.[6]

Joint Capabilities Release (JCR). A digital system of systems that provides situational understanding and awareness from the single vehicle platform to CPs up to ASCCs. The JCR enables messaging, sharing of graphics, and location of individual platforms on the battlefield. Different variations are called Force XXI Battle Command Brigade and Below (FBCB2), Blue Force Tracker (BFT), JCR-Logistics (JCR-Log) and Joint Battle Command-Platform (JBC-P).[7]

Knowledge Management (KM). KM is the process of enhancing knowledge transfer to generate shared understanding, learning, and decision-making.[8]

Mission Command System (MCS). The MCS has five components: personnel, networks, information systems, processes and procedures, and facilities and equipment.[9]

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[6] Joint Chiefs of Staff, JP 1-02, 28.

[7] Ibid., 29.

[8] U.S. Army, Army Doctrine Reference Publication (ADRP) 6-0, *Mission Command* (Washington, DC: Department of the Army, 2012), 37.

[9] Ibid., 40.

Mission Command Digital Master Gunner (MCDMG). A subject matter expert that can operate, maintain, integrate, and train others on the Mission Command Workstation and other digital systems.[10]

Mission Command Information System (MCIS). A mission command information system includes computers (hardware and software), communications, as well as policies and procedures for their use.[11] MCIS was previously called Army Battle Command System (ABCS) before the codification of Mission Command. In the context of this paper, CPOF, AFATDS, JCR, and others will be called digital systems when referred to in general.

Portal/SharePoint. A web page that allows remote users to access and update information in a collaborative manner. The US Army predominately uses Microsoft SharePoint.

Tactical Airspace Integration System (TAIS). A digital system that allows CPs from brigade through ASCC to visualize, plan, and de-conflict airspace usage in "near-real-time views."[12]

[10] Mission Command Center of Excellence, "Mission Command Digital Master Gunner Course (MCDMG)," U.S. Army Combined Arms Center, 1 December 2015, accessed 20 October 2016, http://usacac.army.mil/organizations/mccoe/dots/mission-command-master-gunner.

[11] U.S. Army, ADRP 6-0, 42.

[12] PEO-C3T, 26.

Study Limitations

This research will lay out a potentially effective method for training units on digital gunnery. The author, in conjunction with the Mission Command Center of Excellence (MCCOE), completed a small pilot of a similar program, but it must be applied at multiple echelons across the Army to deem its true merit. The MCCOE has developed an initial set of digital training tables that are similar to what this paper will discuss, but they focus solely on the integration of digital systems, not the entirety of the MCS as a whole.[13] Additionally, this program, if implemented, will only apply to Army organizations, but can be used as a model for other services. As the nature of U.S. war efforts continues to be more joint and multinational forces, integration must receive emphasis. Digital liaison teams are a possible solution to this limitation.

Many of the Army's digital systems found their first use during the Global War on Terror. As such, these systems have had limited use in a decisive action environment. Each system has found application in the counter-insurgency fight in Iraq and Afghanistan, but this is limited and has not built a knowledge base that allows for real integration. Some, like AFATDs pre-date operations in Iraq and Afghanistan, but high intensity fires coordination skills have atrophied with static use from Forward Operating Bases. To better train on higher intensity, unified land operations, the Army started conducting Decisive Action Training Environment (DATE) rotations at CTCs in 2012.[14]

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[13] Mission Command Center of Excellence, "Mission Command Digital Master Gunner Course (MCDMG)."

[14] Michael Barbee, "The CTC Program: Leading the March into the Future," *Military Review* (July-August 2013): 18, accessed 17 October 2016, http://usacac.army.mil/CAC2/MilitaryReview/Archives/English/MilitaryReview_20130831_art006.pdf.

Consequently, this study will focus on DATE CTC rotations that have occurred between 2012 and today. Unfortunately, reports and evaluations from three of the four CTCs (the Joint Readiness Training Center, the National Training Center, and Joint Multinational Readiness Center) are published as For Official Use Only (FOUO). Fortunately, the Mission Command Training Program (MCTP) releases their reports and evaluations as unclassified. The classification issue is a limitation of the study. However, the limitation does not have a negative impact on the study's significance.

Scope and Delimitations

The scope of this research will cover data produced at CTCs. This research will account only for training results and evaluations, with no input from actual combat. Only information from training in the DATE is relevant as this is the environment that requires maximum synchronization of the MCS. Results of the use of digital systems in Iraq and Afghanistan have been positive, but the application of MCS was in a static mode. While echelons from company through ASCC use digital systems, this study will focus on a practical MCS implementation at the division, brigade, and battalion levels.

As this study will attempt to show that combat vehicle gunnery is an effective basis for establishing a digital gunnery program, there will be historical research into the employment and training of teams. Combat crews have operated throughout history from ancient siege equipment to the most sophisticated modern tank. This study will not look at crews before 1880, and will focus on crews of naval weapons, field artillery pieces, and combat vehicles since that time. The process with which these crews trained and developed over time might serve as the basis for digital gunnery of digital systems.

Significance of Study

CTCs report that almost all staffs execute Mission Command (MC) inefficiently. Commanders have trouble visualizing their battlefields, and soldiers cannot find relevant data on their digital systems. In the process of relearning decisive action, the Army must learn how to employ the systems developed during the past fifteen years of counter-insurgency fighting. This study will address how the application of successful training programs on kinetic systems can and will translate to successful training on parallel digital systems. Successful combat system training takes qualified individuals, introduces them to a team, trains the team, and then incorporates that team with other teams. This team or crew in training is set, and personnel cannot shift in or out. Members of the crew only transfer with explicit approval from a higher commander because when a member leaves the crew or team, the team as a whole is untrained and must repeat the process with a new crewmember. For units to employ their digital systems effectively, they must receive the same emphasis as combat systems. Commanders must create rostered crews in CPs, and train the crews to work together. Personnel changes should only happen when necessary.

In summary, this study will seek to determine if principles of training a tank crew, section, platoon, and company through brigade is an effective model that can directly apply to the training of a unit's MCS. Understanding how combat crews have matured during the last 120 years and how the Army's current combat gunnery program works will form the basis of establishing a system that will create units ready to operate CPs in any environment, regardless of the operational complexity. The next chapter will discuss the body of literature surrounding the topics of training gunnery and current training of

digital system operation. The chapter will acknowledge each source and associated contribution to answer the primary and secondary research questions.

CHAPTER 2

LITERATURE REVIEW

The Problem

Today's decisive action fight requires a unified commander and staff team to effectively synchronize and mass their efforts across all domains.[15] Due to the complexity of the fight, the sheer amount of data, and the decentralized nature of decisive action operations, a fully functioning MCS is critical to enable the commander to make the right decision at the right time. The MCS includes a unit's personnel, facilities, equipment, network, information systems, processes, and procedures. While the facilities, equipment, and throughput of the network will always be in flux during a dynamic operation, a unit that has personnel well trained and rostered, has efficient processes and procedures, and can use their information systems effectively, will synchronize their efforts. The current inability to synchronize efforts forms a significant capability gap. This research will look at combat vehicle gunnery training as a model for effective MCS training; specifically training may fill the gap in MCS training; most importantly, the training of the digital systems that allow for staff synchronization. To answer how combat vehicle gunnery training can fill the gap for the MCS training this research will answer five secondary questions.

1. How effectively does the Army currently train operators on the different digital systems?

[15] U.S. Army, TRADOC Pamphlet 525-3-1, *The U.S. Army Operating Concept, Win in a Complex World* (Washington, DC: Department of the Army, 2014), 5.

2. How effectively does the Army employ assigned digital systems to form an effective MCS?
3. How and why did combat vehicle gunnery develop to its current state?
4. How effective is combat vehicle gunnery training?
5. Can the principles and format of vehicle gunnery training be applied to training a staff MCS?

This chapter will discuss the current body of literature applicable to the overarching problem, and four of the five secondary questions. The fifth question is answered in chapter 4 of this paper. The first literature discussion involves MC as a philosophy and warfighting function. Literature discussing training on the MCS will follow. Then, the research will address combat vehicle gunnery training. Finally, the literature review will cover employment of the MCS at CTCs.

The Mission Command Information System

Researching the Army's use of digital systems over the years is complicated. To start, naming conventions have varied over the years. Prior to the Army's use of mission command the term was "battle command." MCIS, as such, were formerly called Army Battle Command Systems (ABCS), and, hearing MCIS referred to as ABCS is still common. Further complicating research are the different acronyms that can describe a system. The CPOF is also the Mission Command Workstation (MCWS), and systems that monitor Blue Force Tracking (BFT) have been called Force XXI Battle Command Brigade and Below (FBCB2), Joint Capabilities Release (JCR), Joint Capabilities Release – Logistics (JCR-Log), or Joint Battle Command-Platform (JBC-P). While each system is

different and distinct, individuals often confuse the terminology, leading to overall confusion about FBCB2, JCR, and BFT.

The Army Research Institute (ARI) has published several important studies on the use of digital systems and the skills required to operate them. Writing in 2001, William Sanders noted that future operations will be distributed, necessitating increased training requirements for digital teams.[16] Additionally, a significant portion of soldiers saw a dramatic decrease in their ability to perform digital tasks after thirty days of not using digital systems.[17] Williams states that the "dynamic nature of digital C4I (command, control, communications, computers, and intelligence) tasks thus requires the development of training programs that can efficiently adapt over time to evolving training demands."[18] Another study by the ARI looks at developing a list of critical skills for the use of CPOF. In doing so, they created a sixteen-page list of tasks.[19] The sixteen pages, however, did not include any tasks related to CPOF connecting with other systems like AFATDS or DCGS-A. They studied how to best train on CPOF, determining that

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[16] William R. Sanders, *Cognitive Psychology Principles for Digital Systems Training* (Arlington, VA: Army Research Institute for the Behavioral and Social Sciences, 2001), 1, accessed 23 October 2016, http://www.dtic.mil/get-tr-doc/pdf?AD=ADA391035.

[17] Ibid.

[18] Ibid.

[19] Richard Catrambone, Richard L. Wampler, and Martin L. Bink, Research Report 1906, *Determining a Critical-Skill Hierarchy for Command Post of the Future (CPOF)* (Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences, July 2009), 37-53, accessed 23 October 2016, http://www.dtic.mil/get-tr-doc/pdf?AD= ADA507712.

learning simple task execution through step-by-step training was not sufficient. Instead, operators needed to learn collaboratively with an interface that adjusts to meet the individual and specific mission needs:[20]

> The ultimate goal for Army digital system trainers is to ensure that Soldiers learn how to operate and employ the family of digital systems to help them accomplish missions on the battlefield. Trainers want Soldiers to be able to solve novel problems, that is, problems that are not just like the examples presented in lecture or in the reference book. Soldiers need to be able to apply the procedures described to new situations. In short, trainers should strive to ensure that users can employ the digital system capabilities to improve the acquisition and transfer of problem solving and procedural knowledge.[21]

Another ARI study by Brooke Schaab and J. Dressel discusses a training approach that can be used to developing soldiers capable of accomplishing challenging and poorly defined tasks. Looking at the initial-entry-training of military intelligence analysts, the study compared two teaching methods. One, which was the conventional method used by the school, focused more on lectures and guided practical examinations. The other, which the authors called the constructivist approach, allowed groups to accomplish tasks together in a less linear environment. The results showed that both groups scored high on the standard end-of-module test, but the constructivist group scored much higher when given an unfamiliar mission on new terrain.[22] However, military intelligence analysts have higher mental aptitudes than the regular soldiers,

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[20] Catrambone, Wampler, and Bink, v.

[21] Ibid., 3.

[22] Brooke B. Schaab and J. D. Dressel, Research Report 1782, *Training for Adaptability and Transfer on Digital Systems* (Alexandria, VA: Army Research Institute for the Behavioral and Social Sciences, December 2001), accessed 15 October 2016, httpwwwdticmilgettrdocpdfADADA399409.

meaning more structured learning might be required for other soldiers.[23] These findings are further refined by Gregory Goodwin's demonstration that training on digital systems is less about learning what buttons to press, and more about how to share, sort, and access data. With the overwhelming amount of data available, this creates a steep cognitive learning curve.[24] While simple motor skills are required, digital systems remain difficult to train because of the complex cognitive requirements.[25] Goodwin uses New Equipment Training (NET) as an example. Most NETs train in a linear, step-by-step process like the military intelligence analysts in the conventional method above. Instead, Goodwin recommends an alternative approach more like the constructivist method from above to allow greater learning without a pre-determined sequence.[26] Thus even non-military intelligence specialties would benefit from a constructivist approach.

The above literature reviewed clearly shows that training on digital systems is difficult, compounded by the fact that the authors were not discussing using various systems together on a distributed network (Williams being an exception). Instead, their focus was on using a specific system: CPOF, the All Source Analysis System, or FBCB2. The next paragraphs will discuss the body of work describing how staffs learn to use a variety of digital systems to function together as a cohesive team.

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[23] Gregory A. Goodwin, Research Report 1864, *The Training, Retention, and Assessment of Digital Skills: A Review and Integration of the Literature* (Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences, November 2006), accessed 17 October 2016, http://www.dtic.mil/get-tr-doc/pdf?AD=ADA470707.

[24] Ibid., 9.

[25] Ibid., 3.

[26] Ibid., 17.

Staff Training on the Mission Command System

The Army has attempted to simplify the training requirements for developing staff to use their MCS. In 2006, the Army drafted a program called Battle Command as a Weapon System, or BCAWS. Mission Command is the current version of Battle Command. The idea was that units would train their battle staff, command and control systems, and headquarters on a set of tasks. A report of the unit's BCAWS training status then goes to Headquarters, Department of the Army on the monthly Unit Status Report.[27] This draft gained little traction. There are very few instances of BCAWS with one notable example being the Kansas National Guard. In 2014, they listed BCAWS with a list of twelve staff drills that must be completed and reported to their Joint Force Headquarters.[28] Staffs were required to train individually and collectively on their digital systems to complete gated staff training tasks as determined by their mission requirements.[29]

[27] Stand-To! "Battle Command as a Weapon System," 17 January 2007, https://www.army.mil/standto/archive/2007/01/17/.

[28] Kansas Army National Guard, Kansas Army National Guard Pamphlet (KSARNG PAM) 350-1, *Training Management* (Topeka, KS: Joint Forces Headquarters – Kansas, 2013), 18.

[29] Ibid., 17.

Table 1. Kansas Table

Table	Title	Training Event Supporting Table	Metrics	Notes
I	Individual staff Warfighter training	Classroom/Lab Instruction in Institution / NET / Unit	Soldiers and leaders are trained in the time tested analog methods of staff operations. Proficiencies demonstrated include ability to perform individual tasks which support critical collective tasks (e.g. information management (IM) and the MDMP).	Individual Training
II	Individual digital training	Classroom/Lab Instruction in Institution / NET / Unit	Soldiers learn assigned ABCS equipment and can perform individual tasks which support IM and the MDMP.	
III	Leader training	Classroom/Lab Instruction in Institution / NET / Unit	Leaders are familiarized with the functions and limitations of the ABCS equipment in their staff cell(s) and function.	
GATE IV	**Individual Integrator**	**Classroom/Lab Instruction in Institution / NET / Unit**	**Soldiers understand how their assigned ABCS equipment integrates into the network. CP NCO leadership can digitally configure his or her cell and function. SoS integrators can configure different cells and functions into a coherent network within the CP and can establish and maintain connectivity to the network outside of the CP.**	
GATE V	**Collective Digital Integration / Command Post Emplacement and Displacement**	**COMEX**	**Command Posts capable of establishing physical networks, configuring servers, routers, switches, and BFA systems; and demonstrating basic functional capability on all systems to include proficiency in horizontal and vertical information sharing.**	**Vertical and Horizontal Training**
VI	Cell/Element training w/o INFOSYS	STX	Cells, and elements Sections, cells, and elements conduct critical collective tasks (e.g.IM and MDMP) without digital enablers. (e.g the Current Operations Cell delivers a shift change without INFOSYS).	Cell/Element Collective Training
VII	Cell/Element training w/ INFOSYS	STX	Cells, and elements conduct critical collective tasks (e.g.IM and MDMP) with digital enablers.	
VIII	Staff Drills	STX	The Staff or CP collectively conducts critical collective tasks using vignettes.	Horizontal Training
IX	Vertical functional training w/o INFOSYS	STX	A staff function is exercised and evaluated without digital enablers (e.g. the fire support warfighting function conducts call for fire training through different echelons of command).	Vertical Training
GATE X	**Vertical functional training w/ INFOSYS**	**STX**	**A staff function is exercised and evaluated with digital enablers.**	**Vertical Training**
XI	Delta Training	Classroom/Lab Instruction in NET / Unit COMEX STX	Soldiers, Cells, Functions and CPs are able to perform critical collective tasks when new digital enablers are introduced. (e.g. If a unit was operating under software version "A.a" and was upgraded to "A.b", training would focus on the changes that software dictated in MDP and IM support).	Vertical and Horizontal Training
GATE XII	**Integrated Command Post training**	**CPX* WFX**	**A unit's assigned CP's full METL is exercised under realistic conditions. As Table XII for armor units serves as a gate for CALFEX, Table XII can serve as a gate for BCBST or BCTP rotations.**	**Integrated Training**

Source: Kansas Army National Guard, Kansas Army National Guard Pamphlet (KSARNG PAM) 350-1, *Training Management* (Topeka, KS: Joint Forces Headquarters – Kansas, 2013), 18.

While very few units implemented BCAWS, the Army developed a school for training personnel to assist a commander with their MCS.

The Army has developed a vital role for training staffs on developing an MCS. This role is the MCDMG. The MCDMG is a position that requires the Additional Skill Identifier 5C from completion of a three-week course at Fort Leavenworth, Kansas. When students graduate, they are a unit's subject matter expert on implementing digital

systems to create a fully integrated CP where the commander can visualize the battlefield through a shared Common Operating Picture (COP).[30] What is key is that the MCDMGs do not operate purely in the operations realm. Instead MCDMGs seek to integrate all warfighting functions into the COP. "That's the bottom line, being able to pull all the systems in and create a good COP so the commander can make better, more informed, faster decisions on the battlefield."[31] Working closely with the MCDMG are Signal-Digital Master Gunners, who assist by maintaining a stable network to support the MCS.[32] To enable MCDMGs as they trained their units on implementing their digital systems, the MCCOE sent all graduates home with a disc that included training scenarios, reference guides, and standard operating procedures. While the take-home products were helpful, they consisted of step-by-step practical exercises.[33] With an enterprising MCDMG, the step-by-step practical exercises could be used to develop an effective training plan, but they did not provide enough to create a fully developed plan that could take individual systems operators and develop them into a functioning staff team. Seeking to develop a better product, the MCCOE began development of a set of ten digital training tables.

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[30] Mission Command Center of Excellence.

[31] Nancy Jones-Bonbrest, "Digital Master Gunner Training Keeping Pace with Latest Technology," *Army Communicator* 39, no. 2 (2014): 22.

[32] Ibid., 23.

[33] Mission Command Center of Excellence, "Mission Command Digital Master Gunner Course (MCDMG)."

Table 2. Mission Command Digital Master Gunner Course

	FORSCOM	Table	*Individual / Digital Crew Training*	
Digital Crew MCDMG Led Certification	Level 1	I	Basic Systems	I.1 Setup the MCIS for Operation
				I.2 Prepare the MCIS for Operation
				I.3 Employ the MCIS
				I.4 Organize CPOF/MCWS Data
				I.5 Exercise Mission Command Under Degraded Conditions
	Level 2	II	Systems Integration	II.1 Share data products with the MCIS/MCIS
				II.2 Create Notifications for Data Changes
				II.3 Implement Appropriate Permissions on MCIS
				II.4 Access Data Through CPOF Data Bridge
		III	COP Development	III.1 Establish the Common Operational Picture (COP)
				III.2 Communicate using MCWS/CPOF/MCIS
		IV	Battle Management	IV.1 Manage SIGACTs
				IV.2 Execute Battle Drills
				IV.3 Develop a Collaborative Mission Plan
				IV.4 Produce a Shared Plan Using MCIS
				IV.5. Present Command Post Update Brief
	Level 3	V	Mission Command System Rehearsal	V.1 Establish the COP
		VI	Crew Certification	VI.1 Establish the COP
			(Collective) Integrated Digital Staff Training	
Commander and Staff MCDMG Coordinated Training		VII	CDR / Staff / Digital Crew (CP) Integration	VII.1 Establish a Command Post in an Operational Environment
				VII.2 Process Relevant Information
				VII.3 Display a Common Operational Picture
				VII.4 Disseminate Common Operational Picture and Execution Information
		VIII	CDR / Staff / Digital Crew (CP) Battle Drills	VIII.1 Coordinate Actions to Produce Maximum Effective Application of Military Power
				VIII.2 Conduct Fire Support
				VIII.3 Develop Running Estimates
				VIII.4 Adjust Resources, Concept of Operations, or Mission
				VIII.5 Conduct an Operations Synchronization Meeting
		IX	Integrated CP Assessment	XI.1 Conduct Command Post Operations
	MCVE	X	CP Mission Command Validation Exercise (MCVE)	X.1 Establish a Command Post in an Operational Environment
				X.2 Conduct Command Post Operations

SCOM Command Training Guidance Levels FY16
el 1 – Individual Skills Level 2 – Publish and Subscribe within organic DDS
el 3 – Subscribe outside of organic BCCS/DDS (ex. Higher HQs, Adj Units, etc. using MCISs)

Source: Mission Command Center of Excellence, "Mission Command Digital Master Gunner Course (MCDMG)," accessed 20 October 2016 http://usacac.army.mil/organizations/mccoe/dots/mission-command-master-gunner.

Application of the Digital Training Table framework provides a linear progression to synchronize training activities for effective of the Mission Command Information System capabilities to assist the staff and Commander's decision making process in support of Unified Land operations.

These tables (see table 2) provide a tool for the MCDMGs to work with a unit's training officers to develop a comprehensive plan to train the staff on how to use digital

systems to support mission command. Digital training to support staff functions received a boost in fiscal year (FY) 2016 when the Army's Forces Command (FORSCOM) training guidance required units to train MCDMGs and S-DMGs, and then conduct MCS training.[34] The MCS training would consist of three levels: basic operator training, integration of multiple digital systems, and then integrated systems with staff support. The three tiers of training lead to a Mission Command Validation Exercise (MCVE) prior to a CTC evaluation.[35] Table 2 displays the FORSCOM levels in green, adjacent to the MCCOE digital training tables. The steps made by the MCCOE and FORSCOM, if applied, can provide a unit the necessary tools to train their MCS effectively. Analyzing the validity of the digital training tables, or digital gunnery training, is a means to answer this study's research questions.

Following the FY 16 FORSCOM training guidance, 1st Infantry Division (1ID) took the MCCOE training tables and ran a pilot program to prepare for WFX 16-04 in May 2016. For five months before the WFX, sixty soldiers from 1ID worked through the training tables to prepare. The result was a staff that exceeded expectations, and enabled a commanding general to effectively employ the staff to fight the enemy, instead of combating the friction of inefficient digital systems use.[36] FORSCOM recognized the

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[34] U.S. Army FORSCOM, *FORSCOM Command Training Guidance (CTG) – Fiscal Year 2016* (Fort Bragg, NC: Department of the Army, 2015), 9-10.

[35] Abrams, 10.

[36] Jonathan Stafford, "Building Digital Lethality," *Military Review* (January-February 2017): 90, accessed 2 April 2017, http://www.armyupress.army.mil/Jounals/Military-Review/English-Edition-Archives/January-February-2017/ART-013/.

impact of 1ID and MCCOE's efforts in their FY17 training guidance. The progress in training staffs at the individual, crew, and collective levels on digital systems was successful enough to direct all divisions to integrate the training into their annual training programs.[37] Despite the success of the program, MCTP and FORSCOM both gave a majority of the credit to the number of MCDMGs that 1ID trained. MCTP specifically highlighted the effort to train and place MCDMGs in the right position.[38] The placement of MCDMGs is important, but fails to recognize that their primary role is to facilitate the digital training tables. Similarly, FORSCOM began the paragraph recognizing the efforts of 1ID and MCCOE by stating the number of MCDMGs and S-DMGs receiving training in FY 16.[39] Even with success attributed to the MCDMGs, the digital training tables, as a basis of digital gunnery training, worked at 1ID because they greatly improved the unit's MCS. As such, it must have implementation on a greater scale.

Combat Vehicle Gunnery Training

There is no shortage of Army doctrine on gunnery training. A simple search on the Army's Central Army Registry of documents produces over a thousand individual results, ranging from training circulars to field manuals to individual and collective training tasks. These tasks apply to individual systems up to entire Armored Brigade

[37] U.S. Army FORSCOM. *FORSCOM Command Training Guidance (CTG) – Fiscal Year 2017* (Fort Bragg, NC: Department of the Army, 2016), 6.

[38] Stafford, 89.

[39] U.S. Army FORSCOM. *CTG – Fiscal Year 2017*, 6. In FY2016, FORSCOM trained three hundred Mission Command Digital Master Gunners and sixty Signal Digital Master Gunners.

Combat Teams (ABCT). As mentioned in chapter 1, this research does not reach further back than the 1800s. Systematic gunnery training and drill predates the 1800s, but this research deliberately focuses on systems dating from 1897 as they have greater range, accuracy, and maneuverability than earlier examples. Training was crucial on earlier weapon systems, such as a Civil War cannon crew, but World War I era artillery crews massing their fires beyond line of sight required much greater precision. The training methodologies used in 1897 are familiar to those in use today. This section will be broader than the discussion concerning MCS. The goal, research supporting, is to show how gunnery training has developed to become a highly effective training method.

Naval Gunnery Training

Naval gunnery grew exponentially more challenging with the advent of the pre-Dreadnought battleship. Captain Herbert Garbett of the Royal Navy, in his book, *Naval Gunnery,* discusses how the guns on a pre-Dreadnought battleship operate in 1897. Between 13.5-inch cannon, Maxim and Hotchkiss guns, and torpedo tubes, the battleship of 1897 has fifty-seven mounted weapons located throughout the ship.[40] Designed around the specific employment of the guns, the ship has a complement of 712 men.[41] Out of these 712 men, three are gunnery instructors, fourteen are gun captains, and 108 are seamen gunners; all personnel who have received special training to aim, judge distance,

[40] Herbert Garbett, *Naval Gunnery; a Description and History of the Fighting Equipment of a Man of War* (London: George Bell and Sons, 1897), 329.

[41] Ibid.

and direct the employment of other men on their guns.[42] The ship has four sections, each with a day and night crew. Every person on the ship has specific functions to perform when called to action.[43] Assigning a duty to an individual and having a trained officer or gunner over him is not enough to be ready to fight. To be ready, the ship has a drill twice daily, rotating by section in a manner that guarantees every weapon station trains least once a week.[44] Every Friday, the ship executes a general quarters drill to test the complete system.[45] Between the four Fridays of a month, each gun on the ship performs all drills as a whole. The drills not only include the firing of the weapons, but simulated malfunctions, replacing parts that could potentially be disabled, firing the weapons with crew members, dead or wounded, supplying ammunition, and dealing with flooding, fires, and collisions (including intentional ramming).[46] In summation, Captain Garbett writes that:

> All the foregoing exercises and drills have to be arranged so as to work smoothly and in conjunction with each other, until, after a ship has been a short time in commission the perfect fighting machine develops from this intricate mass of war material, and is ready to repel any attack that may be made against her, or to deliver a crushing blow to an antagonist, as it only requires the pressure of a single electric button, or a bugle call, to let loose, with terrific force, the enormous pent-up powers that are lying read in her guns, the simultaneous discharge of

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[42] Ibid., 330.

[43] Ibid., 332.

[44] Ibid., 333.

[45] Ibid.

[46] Ibid., 333-36.

> which will make the biggest battleship, monster though she is, shiver and heel to the shock of her discharge.[47]

In the quote, Captain Garbett is describing a complex system that requires a strict training protocol starting with individual systems and culminating with a system as a whole. The teams are pre-established, and led by men specifically trained to lead them.

In 1910, the U.S. Naval Academy wrote the book, *Ordnance and Gunnery,* that discusses the construction of naval guns, types of ordnance they fire, building of batteries and turrets, testing weapons, armor, ordnance penetration, mines, and most importantly – practical naval gunnery. The Academy defines gunnery as "the art of using the ship's guns to the best advantage; that is, in such a manner as to make the greatest possible number of hits in a given time."[48] The text goes on to discuss how gunnery, to be effective, must have accuracy, a high rate of fire, and rapid loading.[49] Giving teamwork extra attention, *Ordnance and Gunnery* states, "Each member of the gun-crew performing his own duty in the service of the gun at exactly the proper time and in exactly the proper sequence, and then getting out of the way so as not to interfere with other members of the crew."[50] Further, the text discusses how a failure by one individual can create failure for the entire gun crew, and how specific duties must remain the

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[47] Garbett, 337.

[48] Officers of the U.S. Navy, *Ordnance and Gunnery* (Annapolis, MD: The United States Naval Institute, 1910), 427.

[49] Ibid., 428-32.

[50] Officers of the U.S. Navy, 431.

same.[51] *Ordnance and Gunnery* next goes on to discuss the roles of individual members of the gun crews, with the division officer (DO) first. Other than being thoroughly familiar with all positions of the crew, the DO must know the functioning of all guns, mounts, and accessories. Most importantly, the DO is responsible for the training of the gun crews and ensuring that all guns can rapidly and accurately fire.[52] Below the DO, the gun-crews have turret-captains, the gun-captains, followed by gun-pointers and sight-setters. Each has a vital role on the team and must work in close cooperation to maximize effects. The gun-captains bear the most responsibility for training because "the gun-crew is being trained for the one great emergency of battle" and the only way to maximally perform "is to train it to do so in time of peace."[53] *Ordnance and Gunnery,* though only following Captain Garbett's text by thirteen years, clearly shows that gunnery has become more complex. Though detailed by Garbett, positions and training requirements are much more specific, and the emphasis on training for speed is much greater in *Ordnance and Gunnery*.

As naval gunnery progressed, so did field artillery gunnery. While there had been numerous improvements in modern artillery before 1913, the First World War provided a catalyst for militaries to train and employ synchronized indirect fire on a massive scale.[54]

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[51] Ibid., 432.

[52] Ibid., 436.

[53] Ibid., 439.

[54] MacGregor Knox and Williamson Murray, eds., *The Dynamics of Military Revolution, 1300-2050* (Cambridge, UK: Cambridge University Press, 2001), 136.

Volume III of *Drill and Service Regulations for Field Artillery*, written in 1917, describes a recognizable progression for gunnery training. Training begins with the cannoneer, followed by the squad, and then the battery.[55] Individuals cannot progress to combined training until meeting sufficient standards. Training will start in a garrison environment and then move through multiple types of terrain.[56] Much like *Ordnance and Gunnery*, the *Drill and Service Regulations for Field Artillery* discusses how accuracy and rapid firing come from thorough and exact training. Unlike the naval texts, the field artillery manual discusses keeping records of how long cannoneers take to conduct their duties and then assign appropriate duties.[57] The training progresses through several steps that are reminiscent of the tables in modern gunnery training. First, the cannoneers learn the equipment: nomenclature, purpose, and operations of different parts of the howitzer, use of sights, types of ammunition and powder. The training then discusses the duties of the gunner in detail. The gunner is taught deflection, siting, ranging, and voice commands.[58] Next, the field manual discusses the duty of each individual on the firing team – gunner, and then members numbered one through eight. Only after training on each position are the cannoneers "permanently assigned to those positions in which they have shown

[55] War Department, *Provisional Drill and Service Regulations for Field Artillery* (Washington, DC: Department of the Army, 1917), 11.

[56] Ibid., 12.

[57] Ibid., 14.

[58] Ibid., 15-24.

themselves most capable."[59] Once trained, the individual gun moves to train as a battery. Much as the single gun is only effective with a well-trained team, the battery is only effective with multiple well-trained teams.[60] *Provisional Drill and Service Regulations for Field Artillery* next discusses the steps used to train and fight a battery. Additional detail goes to the movement, emplacement, and communication between other batteries, units, and aircraft.[61]

British artillery gunnery training had many similarities to that of the U.S. In 1924, *Artillery Training Volume 1*, details how "an army can exert its full power only when all its parts act in close combination."[62] The training volume discusses how each of the army's arms must work in unison with a shared understanding of what the engineers, artillery, infantry, aircraft and cavalry need and provide.[63] Training combined arms is critical, but training must not begin until each battery has sufficiently trained its individuals, sections, and the unit as a whole.[64] Discussing many individual requirements, the manual moves to describing how section training works, stating that training is the

[59] War Department, *Provisional Drill*, 37.

[60] Ibid., 39.

[61] Ibid., 104.

[62] Royal Artillery, *Artillery Training Volume 1, Drill* (London, GB: H.M. Stationary Office, 1924), 12.

[63] Ibid., 12-13.

[64] Ibid., 13.

"foundation of efficiency in the battery."[65] Also mentioned was the requirement to train the command and key staff personnel. These individuals needed to be proficient at their tasks and were trained using skeleton crews to provide the equivalent to a modern-day training response-cell.[66] Once properly trained, the individuals, sections, and staff will begin their battery training.[67] Training is critical, and as such, other batteries support the battery in training. The detailed batteries allow for maximum participation and crew stability.[68] Batteries were able to make improvements on their work after receiving daily and comprehensive feedback on their performance.[69] Finally, next to train are brigades. Brigades train on operational planning, emplacing CPs, controlling the fire of their batteries, managing supplies, and coordinating with other branches.[70]

Both the U.S. and British artillery manuals discuss coordination with other branches, but armored forces did not receive specific mention. Germany took tank training seriously, and had had a robust tank gunnery training program that spent a considerable amount of time training individuals, crews, and units as a whole. The time available to continue training at this level lasted until 1943 when Germany needed to replace their crews at a much higher rate. Generaloberst Heinz Wilhelm Guderian, one of

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[65] Royal Artillery, 31.

[66] Ibid., 32.

[67] Ibid., 33.

[68] Ibid., 35.

[69] Ibid., 33.

[70] Ibid., 36.

the early proponents of armored warfare, drastically cut the training time to deliver combat-ready crews in twelve weeks.[71] Guderian removed all unnecessary training to include drill, ceremony, and even greatly reducing the amount of ammunition-free, or blank ammunition training.[72] Even with superior tanks, better-trained enemy crews could still win. As such, tank gunnery training remained a major factor in the twelve-week process for crews to become battle-ready.[73] The most significant change to training was the removal of a step-by-step training process that trained crews, then sections, followed by platoons. Citing the lack of time, Guderian mandated all training be multi-echelon from the start.[74] U.S training during the same period did not have such significant time constraints.

Field Manual (FM) 17-12, published in 1943, details U.S. gunnery training for tanks. The field manual called for a seventeen-step process that lasted a total of twenty-seven weeks. The first fifteen weeks cover the initial nine steps: basic training, crew drills, simulated firing, proficiency tests, sub-caliber firing, and crew gunnery. The second twelve weeks covered platoon drill: platoon maneuvers, firing, and training in progressively larger elements, to include integration with other branches.[75] The FM

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[71] Wolfgang Schneider, *Panzer Tactics, German Small-Unit Armor Tactics in World War II* (Mechanicsburg: Stackpole Books, 2005), 329-31.

[72] Ibid., 326.

[73] Ibid., 329.

[74] Ibid., 326.

[75] War Department, FM 17-12, *Armored Force Field Manual: Tank Gunnery* (United States Government Printing Office, 1943), 4-11.

highlights that each crew needs to have permanent members that train as a team.[76] While the 1943 manual was an outstanding product, a 1945 review of tanks in the European theater noted that the document was not available early enough to ensure crews received the outstanding training detailed within. The units that received the training material had a much better understanding of how to implement tank gunnery than units that had to invent their own process.[77] Instructions on how to train on the new M4 tank were published in 1943, a year after the vehicles arrived in Europe. Consequently, units trained on the material designed for the M3 tank, published in 1941.[78] Regardless, the reviewing board mentions, "Crew drill is the only systematic method of so familiarizing crew members with their duties that they will function automatically in battle."[79] However, the review mentioned that too much emphasis on the regimented training program could result "in loss of interest and lack of realism."[80]

As combat vehicle systems became more complex, so did the requirements on trainers. In 1983, the BFV was a relatively new piece of equipment. Replacing the decades-old M113 armored personnel carrier, the BFV had a much more sophisticated set

[76] U.S. Army, FM 17-12, 4.

[77] U.S. Forces, European Theater, 18.

[78] Ibid., Appendix 7.

[79] Ibid., 15.

[80] Ibid.

of weapons and capabilities.[81] An analysis of gunnery training for the new BFV identified many issues, but the critical aspect relating to this study had to do with personnel training. Master gunners, the individuals who are specially trained to run a unit's gunnery training, were either not being used properly, or simply did not have enough skill to contribute substantively to training.[82] The training for master gunners did not give them enough knowledge or the right training tools to ensure properly trained units.[83]

Nearly thirty years after that analysis of BFV gunnery training, in 2010 the Army published FM 3-20.21, *Heavy Brigade Combat Team Gunnery*. The newly published FM made significant improvements over previous gunnery training doctrine, and provided many details that earlier FMs left out about master gunner requirements and training as a combined arms team.[84] In fact, the new FM specifically creates a training model that synchronizes all direct fire combat systems with other systems. Training was designed to progress in the traditional manner from individual to squad, then to platoon and company; however, this new FM better detailed how the various arms, to include artillery, would

[81] H. C. Strasel et al., *Analysis of Gunnery Training for the Bradley Infantry Fighting Vehicle* (Sunnyvale. CA: Litton Systems, March 1986), 2, accessed 21 October 2016, http://www.dtic.mil/get-tr-doc/pdf?AD= ADA169239.

[82] Ibid., 78.

[83] Ibid., 79.

[84] U.S. Army, Field Manual (FM) 3-20.21, *Heavy Brigade Combat Gunnery* (Washington, DC: Department of the Army, 2010), 12-8.

culminate their gunnery training together.[85] Each BCT, Stryker, infantry, and heavy (now armored) had a similar FM, with accompanying FMs for sustainment and artillery units as well as an FM for small arms gunnery.[86] Requirements for crew stabilization are very clear; directing commanders to have short and long term plans to rebuild crews if individuals were unavailable. Finally, the FMs created a new numbering sequence for gunnery training as seen in the table below.

Table 3. Gunnery Table Naming Conventions

	Gunnery Table	Title and Purpose
Crew	I	Crew Critical Skills[1]
	II	Crew Proficiency Course[1]
	III	Basic Machine Gun Course
	IV	Basic Main Gun Course
	V	Basic Crew Practice
	VI	Basic Crew Qualification[2]
Collective	VII	Section Proficiency
	VIII	Section Practice
	IX	Section Qualification[3]
	X	Platoon Proficiency
	XI	Platoon Practice
	XII	Platoon Qualification[4]

1 – Prerequisite for live fire
2 – Prerequisite qualification to continue on to intermediate section gunnery
3 –Prerequisite qualification to continue on to advanced platoon gunnery
4 – Prerequisite qualification for combined arms live fire exercises (CALFEX)

Source: Stephen A. Krivitsky, "Evolution of Tank Gunnery: Heavy Brigade Combat Gunnery," *Armor* 118, no. 2 (March-April 2009): 8.

[85] Stephen A. Krivitsky, "Evolution of Tank Gunnery: Heavy Brigade Combat Gunnery," *Armor* 118, no. 2 (March-April 2009): 8.

[86] Krivitsky, 7.

The review of combat vehicle gunnery training shows consistent themes. Naval, artillery, and tank gunnery training has an effective training model that progresses from the individual through crew, to higher elements, with the Germans having the only exemption, which was temporary and during war. The British and U.S. artillery doctrine calls for crew stability, as do the U.S. combat vehicle FMs. Next, this literature review will discuss how the Army uses modern MCS and digital systems during mission readiness exercises.

Combat Training Center After Action Reports on MCS and Digital Systems

The MCTP is responsible for providing rehearsal exercises for deploying units as directed by FORSCOM and the Chief of Staff of the U.S. Army.[87] MCTP creates documents to outline trends from the exercises they run. These documents highlight the shortfalls and successes of brigades, divisions, and corps that complete the exercises. For this research, reports from FY 2012, 2014, and 2015 will determine units' effectiveness at employing their MCS.

During FY 2012, the Army was beginning to transition from training units on counter-insurgency to decisive action.[88] Units shifted their MCS and digital systems use to adapt to a modern adversary. The annual trends showed that the intelligence sections had trouble fully integrating their digital systems. Senior personnel understood their

[87] US Army Combined Arms Center, "Mission Command Training Program (MCTP)," 11 January 2017, accessed 13 November 2016, http://usacac.army.mil/organizations/cact/mctp#.

[88] Barbee, 18.

analytical tasks, but did not have the skills to execute them on their digital systems. Their junior soldiers understood the systems, but were not proficient at conducting intelligence analysis. This meant that two personnel were required to perform a single task.[89] MCTP recommended that the sections conduct training for all personnel on CPOF and DCGS-A to rectify the shortfall.[90]

FY 2014 brought in additional recommendations and observations from units conducting a warfighter exercise (WFX). Units were beginning to have more experience with the systems and used them to a greater extent, which resulted in a greater amount of feedback.[91] In general, units did not have the required proficiency in establishing CPs at the brigade and division level.[92] Units lacked proficiency on their MCS and did not track individual systems or plan to integrate them into the CP.[93] Causing significant issues, MCTP found that staff sections were not synchronized and failed to start, or if started, failed to maintain their section's running estimates.[94] The failure of staff synchronization

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[89] US Army, MCTP FY12, *Annual Trends* (Fort Leavenworth, KS: Mission Command Training Program, 2012), 22, accessed 22 September 2016, https://www.jllis.mil/cfc/Services/JLLISFileRemote.cfc?method=JLLISFileDownloadByGUID&GUID=F8E8249F-FC2E-1490-A27A-F753F3C2812F.

[90] Ibid.

[91] Edward T. Bohnemann, *MCTP FY14 Trends in a Decisive Action Warfighter Exercise* (Fort Leavenworth, KS: Mission Command Training Program, 2014), 57, accessed 19 September 2016, https://call2.army.mil/docs/doc7286/MCTPTrends.pdf.

[92] Ibid., 15.

[93] Ibid., 49, 50.

[94] Ibid., 16, 33.

applied to all warfighting functions as the COP in the Combined Operations and Intelligence Center (COIC) failed to create situational awareness and understanding.[95] The sustainment and protection functions had significant issues, too. For instance, logistic reporting was not rapid or detailed enough to support Combined Arms Maneuver.[96] Smaller, yet critical cells, like Unit Ministry Teams, did not contribute to the COP; some, like legal teams, did not get any space in the CP at all.[97] Fires cells had significant problems, including sending incorrect Graphic Control Measures, leading MCTP's recommendation that units to create a digital sustainment program to prevent similar problems in the future.[98] The issues with COPs and late of synchronization often did not get attention until the WFX was in progress because units failed to conduct a comprehensive communication exercise to validate that their systems were communicating properly, and that sections were communicating the right information.[99] Finally, networks did not have the required technical architecture or efficiency to support synchronized digital operations.[100]

[95] Bohnemann, 16.

[96] Ibid., 35.

[97] Ibid., 40.

[98] Ibid., 29.

[99] Ibid., 51.

[100] Ibid., 52.

Mission Command Doctrine: Philosophy and Warfighting Function

Mission Command (MC) is "the exercise of authority and direction by the commander using mission orders to enable disciplined initiative within the commander's intent to empower agile and adaptive leaders."[101] In all military operations, there are unexpected threats or opportunities that require decentralized responsibility and decision-making. MC enables commanders to effectively "integrate all military functions and actions towards a common goal – mission accomplishment."[102] MC has "six principles: build cohesive teams through mutual trust, create shared understanding, provide a clear commander's intent, exercise disciplined initiative, use mission orders, and accept prudent risk."[103] Apart from the MC philosophy, the MC warfighting function describes the specific roles for which commanders and staffs are responsible. Commanders drive the operations process, develop teams, and inform and influence inside and outside their organizations.[104] Staffs are responsible for conducting the operations process (plan, prepare, execute, and assess), conducting KM and information management, synchronizing information-related capabilities, and conducting cyber electromagnetic activities. Staffs also conduct the additional tasks of planning, implementing, and assessing military deception, civil affairs, network operations, airspace control, and

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[101] U.S. Army, ADP 6-0, Change 2, 1.

[102] Ibid., 1.

[103] U.S. Army, Mission Command, "Maneuver Self Study Program," accessed 3 May 2017, http://www.benning.army.mil/mssp/Mission%20Command/.

[104] U.S. Army, ADP 6-0, 10.

information protection.[105] Commanders organize a Mission Command System (MCS) to support the activities listed above.

The MCS is the "arrangement of personnel, networks, information systems, processes and procedures, and facilities and equipment that enable commanders to conduct operations."[106] This system, the MCS, is what enhances mission accomplishment. Critical to the MCS being successful is the application of KM. The Army has a five-step process that uses KM to align people, their processes, and tools in a manner that creates shared understanding.[107] This shared understanding is what enables the staff to appropriately inform the commander, who can make the right decisions at the right time.

Literature Review Conclusion

In conclusion, the available literature pertinent to the research questions provides a wealth of information for assessment. Mission Command doctrine directs a commander to use the art of command, while their staff uses the science of command to plan and administer operations. A key set of tools for accomplishing this is the MCS. Training on the MCS and its digital systems is not a simple task. Researchers have determined that the cognitive requirements and unstructured nature of the digital systems make them a significant asset, but makes training more challenging than teaching simple motor skills.

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[105] U.S. Army, ADP 6-0, 11.

[106] Ibid.

[107] U.S. Army, Army Technical Publication (ATP) 6-01.1, *Techniques for Effective Knowledge Management* (Washington, DC: Department of the Army, 2015), 1-4.

The MCCOE and FORSCOM have taken preliminary steps towards training a unit's MCS.

Combat vehicle gunnery training is also much more than learning to press a button or pull a trigger. The review of naval, artillery, and tank gunnery training literature shows that there are common items needed for success: primarily, sequential training at echelon, and rostered crews.

Finally, a review of MCTP evaluations shows that the common training for combat vehicle gunnery has not properly transitioned to the MCS. Units are not effectively using their MCS to the maximum potential. The next chapter describes the methodology that will assist in digesting the literature for analysis and interpretation.

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

As addressed in chapter 1, the Army does not effectively train on the MCS. In turn, the failure to successfully use these digital systems disrupts the commander's ability to use the MCS to maximize and mass the effect of today's fighting force. Combat vehicle gunnery training, however, presents a training model that may translate to the MCS as a whole. This chapter discusses the methodology for addressing the efficacy of combat vehicle gunnery training, digital system training, and analyzing how the two can be merged. The literature reviewed in chapter 2 will be analyzed to determine if combat vehicle gunnery training provides an answer on how to fill the gap in MCS use and training. The gap analysis will involve three steps. First, what are current characteristics and performance levels? Second, what are the required future characteristics and performance levels? Finally, what are the gaps between the current and future states?[108]

Starting points for step one are developed from a qualitative analysis of the literature review in chapter 2. For MCS, the analysis will discuss MCTP's evaluation of MCS use during exercises from FY 2013 through 2015. The document review will analyze MCTP's evaluation of MCS. A review of combat vehicle training doctrine analyzes where modern gunnery started, the evolution of gunnery training to current

[108] Business Dictionary, s.v. "Gap Analysis," accessed 28 October 2016, http://www.businessdictionary.com/definition/gap-analysis.html.

systems, and why gunnery training is an effective model. The restated research questions below illustrate this process.

Research Questions Restated

The purpose of this research is to determine how to train staffs effectively on MC as a weapon system through digital gunnery. Four secondary questions will receive analysis in order to answer the primary question effectively. The methodology used to answer each question is below.

Qualitative Analysis

1. How effectively does the Army currently train operators on the different digital systems?
2. How effectively does the Army employ assigned digital systems to form an effective MCS?
3. How and why did combat vehicle gunnery develop to its current state?
4. How effective is combat vehicle gunnery training?
5. Can the principles and format of vehicle gunnery training be applied to training a staff MCS?

Gap Analysis

The image below creates a visual model for the research methodology. The funnel on the left indicates qualitative research where evaluation data from CTCs is studied to determine the current state of MCS use and training. The funnel on the left shows the qualitative research of historical training for various gunnery training systems, which are studied to determine how progress was made from the original systems training to their

training today. An analysis of the bridge or gap between the historical gunnery training and current gunnery training will generate a model to progress current MCS training to the desired state of MCS training.

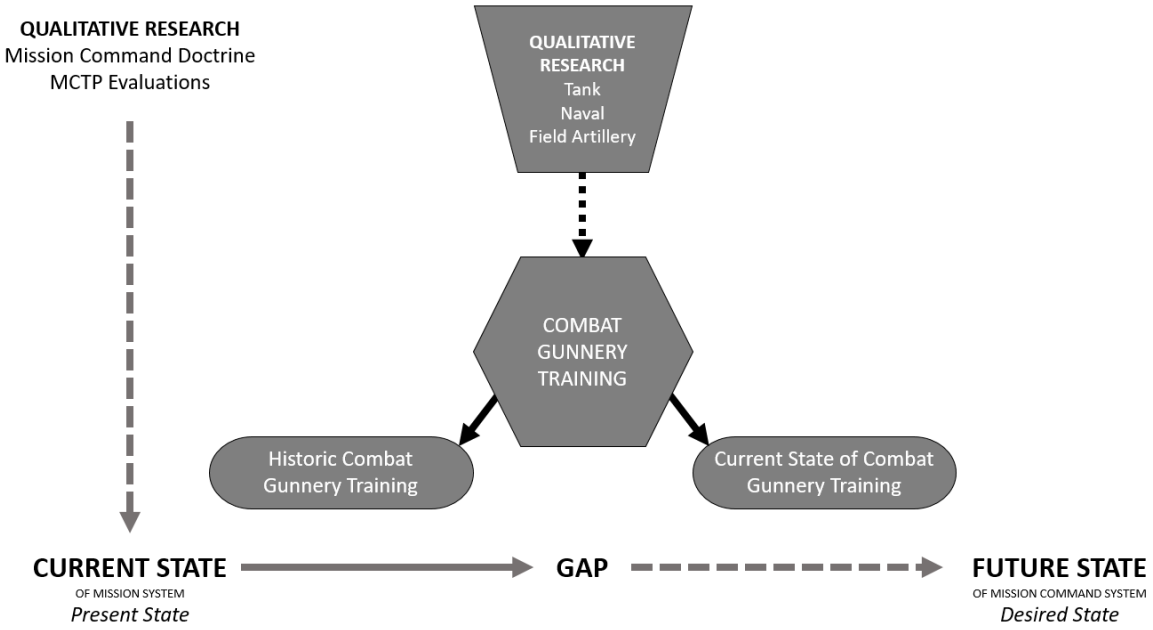

Figure 1. Research Methodology for Applying Combat Gunnery Training to Mission Command System Training

Source: Created by author.

CHAPTER 4

ANALYSIS

Introduction

The purpose of this research is to determine how to best train a staff on MC as a weapon system through digital gunnery. Digital gunnery, adapted from the methodology of combat vehicle gunnery training, uses a regimented program that progresses from the individual to crew, then to the staff as a whole. This study analyzed several additional questions to address if digital gunnery is possible and a valuable method to train a staff on its MCS.

1. How effectively does the Army currently train operators on the different digital systems?
2. How effectively does the Army employ assigned digital systems to form an effective MCS?
3. How and why did combat vehicle gunnery training develop to its current state?
4. How effective is combat vehicle gunnery training?
5. Can the principles and format of vehicle gunnery training be applied to training a staff MCS?

Chapter 1 explained that staffs do not have an effective model for training their MCS. The second chapter began looking at the Army's MCIS, the digital systems that units use to plan and operate with during combat and training operations. Next, literature on past and current forms of staff training on digital systems was reviewed, concluding with the MCCOE's draft digital tables that are the basis of digital gunnery training. After

examining the MCCOE digital tables, the review considers literature relating to combat vehicle gunnery training. The review covers naval, artillery, and tank gunnery training since 1897. The literature review concludes by discussing after action reports from figure 1 describes the methodology used to analyze the literature. MC doctrine, digital systems training literature, and MCTP reports will be used to determine the current state of staffs and their MCS answering how effectively the Army currently trains and employs staff and operators on digital systems. Next, combat vehicle gunnery training, to include naval, tank, and artillery gunnery training, will be analyzed to determine if the current state of training is useful. If proven effective, the gunnery training literature will be reviewed to determine how the training has progressed from the past to current state through a gap analysis. The data from the gap analysis will then be used to determine if the results create a useful model to progress from the current status of staff usage of the MCS to the desired future state.

How Effectively Does the Army Train and Operate its Staffs on the MCS?

The Army is not training its staffs or operators to use their MCS effectively. Chapter 2 lists numerous studies that not only show that training on digital systems is difficult, but that MCTP evaluations indicate a clear lack of proficiency across all warfighting functions. Not only are the systems difficult to learn, but there are often multiple versions of the same system in use across the Army, such as the many Blue-Force tracking variants: BFT, JCR, JBC-P, FBCB2, and JCR-Log. In learning the various Blue-Force-tracking variants, a soldier might know how to operate the FBCB2, but then transition to a unit that uses JBC-P. When this soldier transitions, the unit must then

retrain them on how the system functions. The ARI makes several important observations on the use of digital systems. First, operations in the future will be further distributed, requiring increased digital training to accommodate increased complexity.[109] Second, soldiers completing this training must learn in a manner that expands past simple checklists to a process where teaching collaborative processes leads to individual and mission specific solutions.[110] Third, training must use a constructivist approach that allows for individual and mission specific solutions instead of a simple step-by-step process.[111] Most training on digital systems does not, however, follow this approach. Most training on digital systems, however, does not follow this approach. Instead, digital training tends to take a step-by-step approach, which is evident in MCTP's evaluations of unit's MCS between FY 2012 and 2015.

Despite units such as 1ID and the Kansas National Guard that have developed clear methodologies to train their staffs (see table 1), the Army as a whole has not, until very recently, made any considerable effort to emphasize and encourage staff training. Written for Army-wide implementation in 2006, BCAWS and its required training and reporting task never received codification. The Army later created MCDMGs to address staff short falls in CPs, but the products they took home after qualification were not sufficient for creating collaborative teams that could maximize the MCS. Instead, they received step-by-step training models for teaching units how to accomplish specific

[109] Sanders, 1.

[110] Catrambone, Wampler, and Bink, v.

[111] Goodwin, 17.

tasks.[112] These products are not necessarily bad and are effective to teach basic system skills and synchronization, but they fall short of the constructivist approach studied by Goodwin at the ARI. In 2016, the MCCOE began to correct this issue by releasing the digital training tables as seen in table 2. FORSCOM emphasized this with their training guidance in FY2016. In FY 2017, FORSCOM reiterated the importance of digital training and highlighted 1ID's success, but it overemphasized the importance of having a specific number of MCDMGs on staff versus the importance of the digital gunnery training they can lead in a unit. The efforts by FORSCOM and MCCOE are corrective in nature, showing that the Army does not currently train staffs effectively on their digital systems. The ineffectiveness of staffs is clearly represented in MCTP's evaluation of units completing WFX exercises. As this answer the first research question, the next will address how effectively the Army employs digital systems.

How Effectively Does the Army Employ its Digital Systems?

The literature review in chapter 2 examined three years of MCTP evaluations of brigades, divisions, and corps. Overall, there were twenty-three incidents where units failed to properly use their digital systems, with only seven positive comments. The trend over the three years did not improve, with negative comments tending towards three key areas. First, individuals are not proficient at their systems. The lack of proficiency is not just with senior members but also NCOs. As such, units do not have the experience level necessary to use their systems effectively, let alone train on them. The second trend is

[112] Mission Command Center of Excellence, "Mission Command Digital Master Gunner Course (MCDMG)."

that when units are using their systems, they fail to update them continuously. Staff sections start staff estimates, but consistently fail to update them. Commanders are then stuck looking at incorrect and dated information, which can lead to poor decision making. Finally, the last trend is that units that were using their systems were clearly testing them during their exercise instead of establishing their CPs early to ensure full functionality. It is apparent that most digital system operators only receive introductory and step-by-step training on systems, rarely progressing to collective staff training with the MCS as a whole, making it difficult to complete non-linear problems faced in a validation exercise. The seven positive comments came from units with well-trained system operators. The FY 2014 report sums the overall theme of digital systems use by stating, "Since 1995, the Army's technology and capabilities increase, but many of the best practices and lessons learned on unit staff processes and Mission Command remain constant."[113] The Army is not effectively employing digital systems.

The previous paragraphs answer the first two research questions. First, the Army is not effectively training staff to maximize their digital systems and specifically, their MCS. Second, employment of MCS is not effective, which reinforces that training is ineffective. The next research questions address combat vehicle training and seek to determine if there is a better way to train on digital systems.

[113] Bohnemann, 57.

How and Why Did Combat Vehicle Gunnery Training Develop to its Current State?

Combat vehicles have been a part of warfare for thousands of years. This study narrowed the scope to focus on how training on complex systems has developed since 1897. Ships, artillery, and armored vehicles proved to be ideal systems to study. Ships in 1897, much like today, are comprised of components that function together as an entire system to accomplish tasks. The components, whether a gun, steering mechanism, or engine room, are each run by teams of sailors that must ensure their piece of the whole performs as needed when required. As ships have an obligation to operate at all hours, one set of trained individuals is not enough, requiring multiple teams to ensure around the clock coverage. A regimented training program is required to ensure that all systems function correctly. Captain Garbett, writing in 1897, explains that each element is mastered individually, then collectively. Further emphasizing collective training, the United States Naval Academy published *Ordnance and Gunnery* in 1910. Clearly delineating training duties, the importance of individual, team, and training the ship as a system is emphasized. The similarities between the texts show that the format for training crews is necessary, but the 1910 manual illustrates that the increase in technology and destructive power of the weapons increase the importance a high-functioning crew.

Land systems paralleled those on ships with requirements for well-trained crews and synchronization. One key difference is that individual weapons systems are often spread out further apart than what would be found on a ship, requiring greater training on communication. Overall, the training is remarkably similar to that of ship-based gunnery training. *Provisional Drill and Service Regulations for Field Artillery* written in 1917, discusses terms in a manner very similar to those in *Ordnance and Gunnery*, specifically,

that a successful battery is one that can accurately fires rapidly. The artillery manual does describe manning more clearly, specifying how to track proficiency and assign members to positions that they are best suited. Finally, the 1924 text *Artillery Training Volume 1* from Britain incorporates more emphasis on training with other branches of the military, aviation, engineers, cavalry, and infantry to integrate and maximize the effects of each branch.

One of the branches that artillery would coordinate closely with would be armor. While armor was in its infancy as *Artillery Training Volume 1* and *Ordnance and Gunnery* were published, they were beginning to create their place on the battlefield. Training, however, followed the naval and artillery model. Individuals trained on specific tasks, were then brought together as a crew, and finally as a section or unit in training. American manuals 1943 and 2010, as well as after action reviews of the Second World War and other armored force training documents all highlight the necessity of the step-by-step training process. Only the Germans in 1943 had a different training method, when all crews were required to be combat ready in twelve weeks, a requirement that removed the ability to train as single tanks, then progress to training with larger numbers of vehicles. Generaloberst Guderian did not implement this policy because it was superior. Instead, he did so because the requirement for trained crews on all fronts of the war minimized the time available to train crews.

In answering the secondary research question of how combat vehicle gunnery training progressed to the current state, the best answer, when looking at naval, artillery, and tank gunnery training since 1897, it is clear that the fundamentals are there and have only matured with time. A regimented system that trained an individual gunner or loader

on an 1897 ship is fundamentally the same as training the gunner or loader in a modern tank. The same goes for training the different turrets on a ship or an individual tank. Finally, the training of the ship as a whole or an entire formation of tanks remains the same. The differences between training in 1897 and today are refinements. The greater precision and complexity of systems called for greater amounts of individual training, which led to creating battle rosters. The later digitization of systems and availability of high-fidelity simulators creates situations where crews establish a high level or proficiency before ever firing live ammunition, yet the system has not substantially changed. Wolfgang Schneider, in his *Panzer Tactics, German Small-Unit Amor Tactics in World War II*, mentions how modern crews, with simulations, can achieve an almost "do-it-in-your-sleep" amount of proficiency.[114] Once complete with the simulations, crews transition to firing live ammunition. As such, the greatest change from gunnery training in 1897 to now is that modern crews are can technology to train with repetitions that would have been impossible for Captain Garbett as he trained men on Hotchkiss, Maxim, and 111-ton guns.

How Effective is Combat Vehicle Gunnery Training?

The final research question asks how effective combat vehicle gunnery training is. The question is harder to answer than it seems. The answers to the previous questions show that combat vehicle gunnery has not fundamentally changed in the last one hundred years. However, because something is unchanged does not mean that it is effective.

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[114] Wolfgang Schneider, *Panzer Tactics, German Small-Unit Armor Tactics in World War II* (Mechanicsburg: Stackpole Books, 2005), 350.

Wolfgang Scheider argues that even superior technology does not guarantee victory and German tankers in the Second World War learned that better-trained crews in inferior vehicles could prevail.[115] A more modern example comes from Desert Storm where General Normal Schwarzkopf said, "had the two sides switched equipment, the United States still would have won its lopsided victory."[116] General Schwarzkopf was illustrating that the several decades of technological advancement American tanks had over those of the Iraqis was less important than the superior training. At best, the answer to this question is that combat vehicle gunnery training is critical for battlefield success.

Can the Principles and Format of Vehicle Gunnery Training be Applied to Training a Staff MCS?

According to ADP 6-0, the MCS components enable the philosophy and warfighting function of Mission Command.[117] Evaluations of units completing warfighter exercises show that the Army is not training on or using their digital systems effectively (see questions 1 and 2 above). ADP 6-0 illustrates the desired state of the MCS, and the evaluations at warfighter exercises describe the current state.

Analysis of gunnery doctrine since 1897 shows that the method of training has not changed. The changes that are present are technology driven and have greatly increased the fidelity and number of training iterations. The gunnery training format, however,

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[115] Schneider, 329.

[116] Winslow Wheeler, "Not All That It Can Be," *Foreign Policy* (12 October 2012): 1, accessed 20 February 2017, http://foreignpolicy.com/2012/10/12/not-all-that-it-can-be/.

[117] U.S. Army, ADP 6-0, iv.

remains a model for training the MCS with only two adjustments. First, combat vehicle gunnery training requires accurate targeting at the right time. Most evaluations of combat vehicle gunnery training assign specific scores according to how well the target was hit and if it was hit with the proper timing. A crew, section, or unit are successful at gunnery if they achieve the minimum scoring standard. Digital gunnery training, on the other hand, is much more subjective and cannot be graded on a simple chart. Instead, units must develop their own requirements for evaluating each component of their MCS. These requirements will be informed by the unit's mission essential task list and their specific assigned mission. The second adjustment is that the MCS, and particularly the digital systems component, are not operated in the same linear fashion as weapon systems. Instead of operating as a linear process of target identification, acquisition, weapon selection, and engagement; digital systems and their operators have a more abstract approach to task accomplishment.[118] Dealing with information as both the inputs and outputs to and from the MCS, digital gunnery training must take a constructivist approach to training cognitive skills. The framework, which is effective for combat platforms, allows for training each step in a constructivist manner.

Accommodating the differences means that digital gunnery training can follow the effective model of training individual, crew, and a staff MCS as a whole. The digital gunnery training tables (table 2) can parallel the same unit's combat vehicle gunnery

[118] Combat vehicle gunnery training will not change, regardless of a unit's mission. When a M2A3 BFV goes through gunnery, the process is in accordance with FM 3-20.21 with only very few localized adjustments. The process remains the same for an M1A2 Abrams, AH-64 Apache, or M109 Howitzer. Mission specific training is conducted parallel to, or after combat vehicles have completed standardized gunnery training.

tables (table 3). While the evaluation criteria for combat vehicle gunnery training will remain constant, the digital gunnery training program will have each of its ten tables locally adjusted to prepare a unit for their assigned mission. This does not mean a unit creates an entirely new program, instead when they develop specific staff processes and products, like a COP, their development will focus on mission specific requirements. Studies by the ARI, detailed in chapter 2, explain that digital training requires adaptive training programs that can deal with novel ideas.[119] While the standard step-by-step approach that best describes combat vehicle gunnery training is appropriate for initial digital systems training, the focus must shift to a constructivist approach where soldiers are taught to accomplish tasks in a non-linear approach.[120] The non-linear approach will enable soldiers to better deal with unique and unfamiliar problems to receive information, process the information according to their digital system and job function, then share it in a manner that develops staff knowledge and understanding. Scores, like those in combat vehicle gunnery training, will not be assigned. Instead, units will use task lists to determine if they can sufficiently accomplish tasks to progress to the next level. Many of these tasks are standardized and available from the Army, but some will require local production.

A digital gunnery training program requires more input than the traditional combat vehicle process, but it will focus the training and ultimately save time by creating an effective MCS early. CPs will become more agile and units will save money as

[119] Catrambone, Wampler, and Bink, 3.

[120] Schaad and Dressel, vii.

contract field service representatives will not be necessary to run systems. Instead, soldiers will have enough skill to manage the network and digital systems for themselves. Additionally, the digital gunnery training program, when integrated with traditional combat vehicle gunnery training, is complementary and both processes benefit from one another. Chapter 5 will discuss specific recommendations for implementing a program.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This research has determined that the combat vehicle gunnery training method is a viable option for training a unit's Mission Command System. The determination was arrived at by showing that there is a clear need for improved MCS and digital systems training. Digital systems operators are trained ineffectively, and education programs are not sufficient for developing soldiers capable of solving unique and non-linear problems found on the modern battlefield. Training is only introductory and system specific. When units come together for collective training, they underperform. Three years of MCTP evaluations show a near-universal lack of digital systems proficiency.

Combat vehicle gunnery training has been effective and changed little since 1897. The model followed by pre-dreadnaught battleships is similar to the methodology used by modern tank crews. Changes to combat vehicle gunnery training have been evolutionary and driven by technology to improve repetitions and develop greater proficiency. In the scope of this study, there was only one instance of a deviation from the stepped progression from individual, to crew, and finally to the collective level. The deviation was a deliberate, risky, but necessary decision made by Guderian to speed tank crews to the front lines in World War II. Consequently, the principles and format of combat vehicle gunnery training applies to training staff on digital systems and their MCS. How, then, does a unit apply combat vehicle gunnery training to build digital system proficiency and effect staffs?

Recommendations

The recommendation of this thesis is that all Army divisions, brigades, and battalions implement digital gunnery training as a means to develop their MCS into their annual training plans. This recommendation aligns with a directive in the FY17 FORSCOM training guidance, building from 1ID's pilot program with the MCCOE. The remainder of this chapter will focus on giving generic examples for training and manning digital systems and the MCS. Considerations for battalions, brigades, and divisions will also be discussed. The Digital Training Tables (table 2) created by the MCCOE define the framework to train a staff and the unit's MCS. This recommendation will build upon the MCCOE's tables to include specific recommendations for each component of the MCS throughout the ten tables.

At each echelon, the first step is to assign responsibility for the digital gunnery training program to an individual. Much like the master gunners for weapon systems at division, brigade, and battalion levels, there is one person with the overall responsibility for facilitating the program. The unit's commander will ultimately be responsible for the program, which will also have oversight from the operations officer, but there must be a specific individual with authority to plan and manage digital gunnery training. The leader of the digital gunnery training program must be qualified as a MCDMG. Below the MCDMG will be the staff crews. The crews will be broken down with greater detail in paragraphs below, but at a minimum, a unit will have a day and a night crew, enabling continuous operation. All system operators are rostered, which enables team cohesion and continuity. Changes in personnel are only possible with permission from the commanders of battalions or brigades and at the division, by the chief of staff.

Each crew is to be led by an MCDMG. At each level, the MCDMGs will ensure proper training of individuals, then the crew as a whole. The lead MCDMG then trains the unit staff's digital systems operators as a whole. The MCCOE's ten steps in table 2 form a basis of training for each unit, which can be adjusted to meet specific unit requirements. Finally, the lead MCDMG must coordinate with key personnel from across the staff to synchronize full MCS integration into the digital gunnery training to prepare the entire staff. The MCS includes networks, personnel, facilities and equipment, information systems, and process and procedures.

The primary focus of digital gunnery training is on information systems like CPOF and AFATDs, but it provides the ideal framework for training the MCS as a whole and is critical for staff efficiency.[121] The communications section must provide an effective network; each section must provide the correct personnel with proper training, the operations officer and their senior enlisted support provide the facilities and equipment, and the knowledge manager assists in integrating the processes and procedures originating from across the staff. The lead MCDMG's role is to synchronize these to ensure the effective use of a unit's information systems to achieve mission success. While many of these components will receive refinement during digital gunnery training, each must be extant in at least draft form before the MCDMGs can begin their work.

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[121] U.S. Army FORSCOM. *FORSCOM Command Training Guidance CTG – Fiscal Year 2017* (Fort Bragg, NC: Department of the Army, 2015), 10-11. The command training guidance lays out several items that must receive more training as units develop proficiency. Command Post employment, Chemical, Biological, Radiological, and Nuclear, and Cyber Electromagnetic Activities are all listed. These are incorporated into the Digital Training Tables (tables 4 and 5) in this thesis.

Tables 4 and 5 below show how the digital gunnery training tables must nest with the components of a unit's MCS. The columns indicate which training table is occurring and the rows illustrate the integration of MCS components. Finally, the bottom row shows what training event is stimulating the training.

Table 4. Digital Training Tables I-V and Mission Command System Synchronization

Mission Command System Component	Table I Basic System Skills	Table II Integration Proficiency	Table III COP Development	Table IV Battle Management	Table V Mission Command System Rehearsal
Personnel	Identify and train system operators and key personnel: MCDMGs, S-DMGs, KMO, Battle Staff	Roster crews. Validate understanding of their specific crew's contributions to the overall CP	Practice sending section and skill specific products through the DDS to create a COP as well as parallel analogue products	All personnel train and rehearse to demonstrate thorough understanding of SOPs, Battle Drills, and Reporting Procedures. Operations continue under CBRN conditions	All personnel are able to establish their systems and fulfill their roles in establishing, breaking down, relocating and re-establishing the CP with limited degradation of mission oversight
Networks	Perform all necessary updates, create network diagrams	Ensure all systems are functioning	Validate network enables information systems to properly share and display higher adjacent, and lower COPs	Conduct drills for degraded network conditions, cyber defense, and relocating CPs	Network operates without fiber connections (except where necessary for exercise stimulation)
Information Systems	Ensure all systems are operational and current (reset if needed): CPOF, AFATDs, Portal, JCR, DCGS-A, TAIS, AMDWS	Validate that all systems can publish and subscribe to the DDS as well as higher, adjacent, and lower units	Ensure that all system are publishing accurate data in the correct format to be integrated into the COP to be displayed in the relevant MCIS	Information systems are effectively used to collaboratively plan and distribute plans, execute battle drills, and present information	Information systems are able to set up, break down and operate in field conditions and seamlessly transfer command to alternate CPs during relocation
Processes and Procedures	Assess current staff processes and procedures: Planning SOP, Tactical SOP, Knowledge Management SOP, Battle Drills	Train on KM processes for sharing information on information systems. Develop adjacent analogue tracking mechanisms	Validate the COP format and ensure adherence to SOPs	Format and information flow for plans, orders, battle drills, CCIR, and briefings are rehearsed and validated over the primary MCIS systems and FM	Validate SOPs in field conditions
Facilities and Equipment	Assess current Command Post plans: Floor Plan, Power Grid, Tables/Chairs, Cable Management, Vehicles, Security, Camouflage	Validate arrangement of equipment by setting up tents, tables, chairs, power grid, and vehicle CPs in motor pool	Ensure CP is properly configured present the COP in digital and analogue forms Use Reconfigurable CPs in Mission Training Complex	Refine CP configuration and force protection Validate mobile CPs, CP relocations plans, and shifting control to alternate CPs Camouflaged CPs established at Mission Training Complex	Execute CP relocation for all nodes All CPs set up at Mission Training Complex and conduct relocation drills to training areas
Overarching Event	**Individual Training**	**Crew/Section Training**	**STAFFEX**	**CPX 1**	**CPX 2 – at MTC**

Source: Created by author with information from U.S. Army, ADP 6-0 ((Mission Command System components) and the Mission Command Center of Excellence (Digital Gunnery Tables)

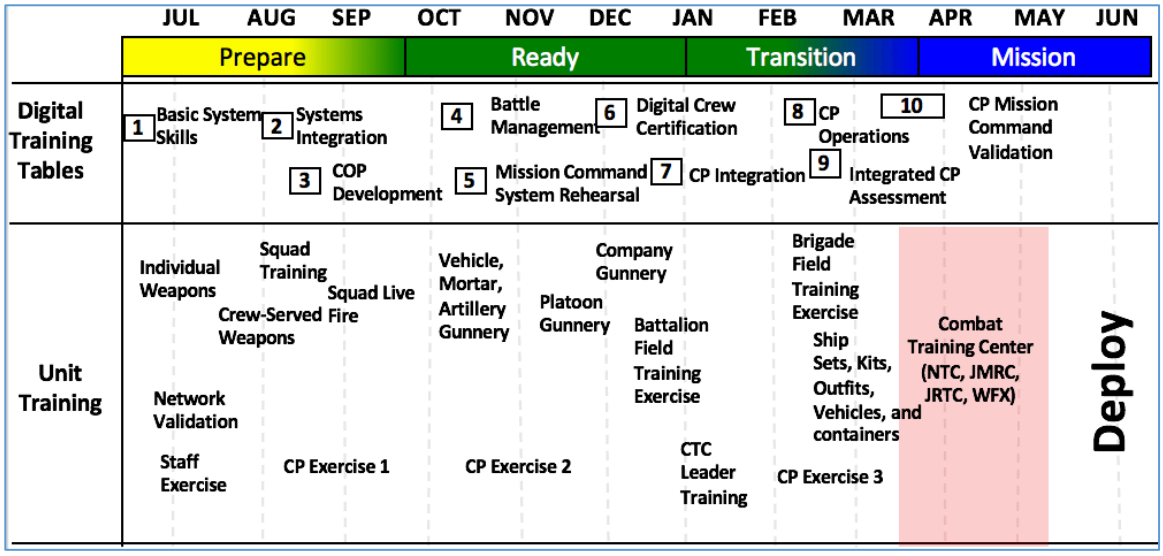
Table 5. Digital Training Tables VI-X and Mission Command System Synchronization

Mission Command System Component	Table VI Crew Certification	Table VII Integration	Table VIII CP Battle Drills	Table IX Integrated CP Assessment	Table X Mission Command Validation Exercise
Personnel	Same Tasks as Table V. Conducted after relocating CPs	Personnel systems further stressed by inclusion of non-simulated subordinates	Rostered crews continue to develop proficiency New individuals are integrated through make-up/continuity digital training tables	External observers validate that all personnel are sufficiently trained and prepared to attend their MRX	Certify that all personnel are sufficiently trained and prepared to assume the unit's mission and/or deployment
Networks		Networks fully operating on tactical systems. Exercise includes network intrusions and degradation.	Professional cyber opposing forces used to test networks	External observers validate that networks are operational and prepared to receive certification at the MRX	Certify that all networks are operational and sufficient to assume the unit's mission
Information Systems		Digital systems fully implemented to track live subordinate units as they maneuver and operate against a simulated enemy with live ammunition	Commander and staff facilitate seamless mission command despite multiple CP relocations, degraded networks, and transferring control alternate CPs	External observers validate that all information systems are being properly employed to support mission command and ready to be certified at the MRX	Certify that all information systems are properly integrated and being used to enable to mission command
Processes and Procedures		Digital and analogue processes are stressed to efficient CP operations to include additional stress on sustaining subordinate units maneuvering with live ammunition	SOPs are refined from previous exercises Complex artillery and aviation support integrated	External observers validate that processes and procedures enable synchronization in planning and operating SOPs are fully understood and ready to be certified at the MRX	Certify that all processes and procedures are fully developed and understood. Unit is able to implement them across a range of operations
Facilities and Equipment	All vehicles, personnel, sets, kits, and outfits receive CBRN decon-tamination	CPs are relocated multiple times and command vehicles that would co-locate with a subordinate main effort conduct parallel live ammunition	CPs are streamlined and refined based on feedback from previous exercises Continued training relocating CPs and operating under degraded conditions	External observers validate that all facilities and equipment are being effectively and appropriately employed	Certify that all facilities and equipment are being properly used and are prepared to assume mission and/or deploy
Overarching Event	**CPX 2 – in Field**	**Subordinate Unit Gunnery**	**BN FTX**	**BDE FTX or CPX 3 (Division)**	**MRX at CTC**

Source: Created by author with information from U.S. Army, ADP 6-0 (Mission Command System components) and the Mission Command Center of Excellence (Digital Gunnery Tables))

Each of the ten training tables created by MCCOE presents a unit with the opportunity to fully develop its MCS in time for a CTC evaluation. Table 6, below, shows the process on a generic annual training plan.

Table 6. Annual Training Plan with Digital Training Tables and Major Training Events



Source: Created by author.

The calendar demonstrates how the MCCOE's digital training tables, when overlaid on a training plan, can work in unison with the other training events a unit must accomplish. The focus is on maneuver units, but units in support roles can easily adapt the program to develop their digital system operators and MCS. The paragraphs below discuss the specific requirements at the division, brigade, and battalion level.

Division Digital Gunnery Training Recommendations

Divisions have the largest requirement for personnel to be qualified on digital systems. With a staff that controls thousands of personnel spread far beyond the line of sight, it is critical that the MCS be sufficiently enabled to allow for coordination and synchronization in combat. The training requirement for MCDMGs and digital system operators is significant. To start, each section (for instance, operations, intelligence, and communications) must have two trained MCDMGs. A trained MCDMG in each section allows an integration expert to ensure their specific products are properly feeding to the COP. These personnel are ideal candidates for the section's knowledge management representative, the soldier responsible for working with the knowledge management officer to ensure processes and procedures are followed to facilitate effective decision-making.

Beyond each section having a MCDMG, each crew must also have at least one. The division will have four crews at a minimum: the main CP and the tactical CP, each with a day and night shift forming crews. It is important to note that this is the minimum requirement, as each division will configure in a manner appropriate for its mission. During WFX 16-04, 1ID developed a sustainment area CP, which added two additional crews, for a total of six.[122] The section and CP requirements led to 1ID requiring twenty-one MCDMGs.

The training focus for divisions puts heavy emphasis on developing and executing plans that allow for effective control of direct and indirect fires in addition to controlling

[122] Stafford, 88.

the efforts of multiple maneuver and support brigades. Controlling fires and maneuver will place a heavy emphasis on three digital systems: DCGS-A, AFATDS, and CPOF. DCGS-A creates the intelligence necessary for effective planning and targeting while AFATDS enables fire support coordination and control. CPOF acts as the overarching digital system for planning, distributing, and executing orders during operations. Brigades receive orders and input primarily through CPOF. Other digital systems like TAIS and AMDWS are necessary for deconflicting airspace and providing warning for enemy missiles.

Stimulating the division's digital systems will occur with several differing levels of complexity. The first three tables of digital gunnery training have inputs from the lead MCDMG to drive specific learning objectives and outcomes. For instance, during the staff training exercise (STAFFEX) (Digital Training Table 3), pre-established CPOF events can be pushed on a schedule to drive staff planning. The complexity increases as CPXs begin. Low-overhead programs like the Division Exercise Training and Readiness System (DXTRS) can be integrated, but this adds additional training for soldiers. Instead, the division should synchronize training with the Mission Training Complex and Simulation Officers to develop fully stimulated exercises.[123] While a fully stimulated exercise will have additional workforce requirements, the professional staff will greatly assist as units strive towards achieving their training objectives.

Table 6 is a guide for developing the digital system operators and MCS of the division staff. Four key training events are ideal for preparing for a WFX, the preferred

[123] Mission Training Complex integration will provide much greater fidelity in stimulating the fires and intelligence systems of a unit.

event for certifying a division. First, is a STAFFEX, followed by three command post exercises (CPX). Each exercise adds increased requirements as illustrated in tables 4 and 5. For instance, the STAFFEX occurs at the installation's Mission Training Complex in a reconfigurable TOC. The focus is on staff processes and integration of digital systems, not setting up and establishing full CPs. Successive CPXs, however, gradually increase the requirements to the point where full CPs are established and moved multiple times within the exercise. Each CPX allows the division to practice transitioning control between CPs during moves as well as teaches crews how to operate in degraded conditions. Brigades have a narrower focus than divisions, and this will be discussed next.

Brigade Digital Gunnery Training Recommendations

A brigade will have smaller sections and digital crews than the division, which reduces the required number of MCDMGs. Not every section will need to have one, but each CP needs to have one on duty at all times. With the main CP, a tactical CP, and the brigade support area, each with a day and night shift, the brigade must have a minimum of six MCDMGs.

Brigades receive direction from divisions and control the movement of subordinate battalions and their fires. A significant difference between division and brigade are the digital systems that their subordinates use. Brigades tend to operate the same systems as a division, though in much smaller numbers, while a battalion predominantly uses JCR and AFATDs. Brigades, then, must operate their digital systems in a manner where they receive guidance in CPOF, but give guidance to their battalions in a format easily displayed on JCR. Operations and sustainment must work to reduce the

complexity of the data received from division to ensure the proper graphic control measures and logistics information are presented in JCR and JCR-Log, respectively.

The training requirements for brigades require less assistance from the Mission Training Complex, but early integration to synchronize and plan training will greatly increase quality. Integrating training aids like the Home Station Instrumentation Training System[124] will enable CPs to integrate the Digital Training Tables into the already planned training of their subordinate units (battalions, in this case). Battalions, the smallest staff of the three units discussed, have the fewest digital systems and operators.

Battalion Digital Gunnery Training Recommendations

Battalions have the smallest requirement for digital systems operators and crews. A requirement of two MCDMGs will allow for training the staff of digital systems and operating the main CP with a day and night crew. The requirement for personnel is lower because, during high-intensity conflict, a battalion will likely be in constant motion, meaning that CPs are operated out of vehicles, or at most, small tents. While battalions do have CPOF, they may be unable to set the systems up due to time restraints. Operating out of vehicles means that JCR, the digital system in most vehicles, is the primary tool for conducting mission command during operations.[125] Consequently, battalions must decide early how and what systems will receive training emphasis. If the unit is preparing to deploy on an advise and assist mission, training on CPOF and in a full CP might be the

[124] The Home Station Instrumentation Training System, or HITS, allows for soldiers, vehicles, and weapons to be tracked and recorded. The tracking occurs in an architecture that allows it to be fed into MCIS and other digital systems.

[125] JCR, or a similar member of the blue-force-tracking family of systems.

best option. If the battalion is preparing to operate in a decisive action environment, its focus must be on highly mobile digital systems like JCR.

Stimulating the battalion's digital systems can be accomplished with minimal assistance from the Mission Training Complex. Early and detailed planning will enable the unit develop a scenario that enables DXTRS to stimulate training, or even from higher-fidelity options like the Joint Conflict and Tactical Simulation Enhancements (JCATS).

The division, brigade, and battalion are already planning to train their maneuver and fire systems. Instead of training digital systems and the MCS as an afterthought, units must integrate their training into an overall, integrated gunnery plan. An integrated gunnery plan will enable the MCS to develop and mature, leading to greater effectiveness of the lethal systems.

Conclusion: Combat Vehicle Gunnery Training Works

Naval crews in 1897, artillery crews in 1924, tank crews in 1945, and combined-arms teams in 2015 illustrate that the method is a practical means to develop efficient fighting organizations. Well-trained individuals progress to comprehensive training as a crew on a system. The crew and their system then train collectively with other crews. In an Armored Brigade Combat Team, this process starts with a single soldier, and culminates with a combined-arms force, incorporating helicopters, tanks, artillery, infantry, engineers, and armored vehicles, all with live ammunition, working in unison to defeat a simulated enemy. The teams are then rostered, ensuring that there are no personnel changes to degrade the effectiveness of the organization.

Unfortunately, the mission command system, that is, the facilities, information systems, networks, processes and procedures, and personnel that enable a commander and staff to plan and then lead these organizations, rarely receive dedicated training. Personnel are not trained and then rostered to prevent staff turbulence, information systems receive training as an afterthought, networks are insufficient, processes and procedures form too late, and facilities and equipment do not receive enough hands-on training. Instead, processes and systems emerge in stride, taking away valuable energy from a live-fire exercise or CTC rotation. As such, digital gunnery training, based on the format used by combat vehicles, must be a regular part of all unit training plans. Developing digital proficiency and a mature mission command system using the recommendations above, will enable commanders to employ their combat systems better, leading to greater lethality against the enemies of the United States.

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